

Earth's Atmosphere

ES-4 The student will demonstrate an understanding of the dynamics of Earth's atmosphere.

Key Concepts for ES-4:

Atmosphere: structure (troposphere, stratosphere, mesosphere, thermosphere, exosphere), gas composition - ozone; thermal changes (tropopause, stratopause)

Convection cells: tropical, temperate, polar

Climate influences: latitude, topography, elevation, water proximity

Wind belts: trade winds, westerly winds, polar winds

Global climate change: ice ages, interglacial period, El Nino

Weather: air masses, high and low pressure systems, frontal boundaries

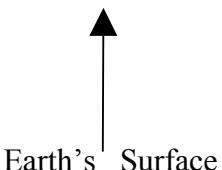
Storms: thunderstorms, hurricanes, tornadoes

ES-4.1 Summarize the thermal structures, the gaseous composition, and the location of the layers of Earth's atmosphere.

Taxonomy level: 2.4-B Understand Conceptual Knowledge

Previous/future knowledge: Students have encountered a study of moving “air” in 2nd and 4th grade and a study of gases in 3rd grade. Students were introduced to the concept of Earth's atmosphere and layers in 6th grade (6-4.1). This study included the identification of the layers; the gas composition within the layers, and differences in temperature within the layers. In Earth Science these concepts are revisited as students develop an understanding of the complexity of Earth's atmosphere.

It is essential for students to know that Earth's *atmosphere* is the layer of gases that surrounds the planet and makes conditions on Earth suitable for living things. It is a mixture of chemical elements and compounds differentiated by distinct differences in temperature with increasing altitude. This thermal structure differentiates the layers:

<p>Atmospheric Temperatures</p>	<p>Differences in temperature separate the layers.</p> <ul style="list-style-type: none"> • The cold regions of outer space extend from the <i>exosphere</i> • Even though the air is thin in the <i>thermosphere</i>, it is very hot; temperature increases as altitude increases • The <i>mesosphere</i> is the coldest layer; temperature decreases as altitude increases • The <i>stratosphere</i> is cold except in its upper region where ozone is located; high temperature zone, called the <i>stratopause</i>, marks the upper boundary • As altitude increases, temperature decreases in the <i>troposphere</i>; at the upper boundary, the <i>tropopause</i>, temperatures stop decreasing
<p>Atmospheric Layers</p> 	<p>Earth's atmosphere is divided into several different <i>atmospheric layers</i> extending from Earth's surface outward:</p> <ul style="list-style-type: none"> • the <i>exosphere</i> • the <i>thermosphere</i> • the <i>mesosphere</i> • the <i>stratosphere</i>, where the ozone layer is contained • the <i>troposphere</i>, where all weather occurs

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Atmospheric Gases	Nitrogen (N ₂) and Oxygen (O ₂)	• the two most common gases; found throughout all the layers
	Ozone (O ₃)	• a form of oxygen found in the stratosphere; in the upper atmosphere protects Earth's inhabitants from harmful ultraviolet rays of the Sun
	Water vapor (H ₂ O) and carbon dioxide (CO ₂)	• most important compounds in the atmosphere; important gases for weather conditions; found in the troposphere
	Trace gases, for example argon	• play an insignificant role

It is not essential for students to know the exact distance between each layer or the specific temperatures of the layers, or how the oxygen-carbon dioxide cycle and nitrogen cycle maintain stable amounts of those gases in the atmosphere. They do not need to compare the properties of pure air with air containing particulate matter and unnatural gases, polluted air, although this discussion would be interesting to increase the understanding of the effects of contaminants on pure air.

Assessment Guidelines:

The objective of this indicator is to *summarize* major points about the layers of Earth's atmosphere; therefore, the primary focus of assessment should be to generalize major points about the temperature differentiation in the layers, the gas composition of the layers, and the location of the layers in respect to Earth.

In addition to *summarize* appropriate assessments may require students to:

- *compare* one layer to another;
- *sequence* the layers from Earth outward; or
- *recall* gasses that are found in the atmosphere as to abundance and importance.